

Physical and Microbial Quality of Broiler Chicken Meat Soaked in *Syzygium polyanthum* Infusion with Different Storage Time

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ABSTRACT

Chicken meat is highly nutritious but also easily damaged. The aim of this study was to evaluate the soaking chicken meat effect in bay leaf (*Syzygium polyanthum*) infusion. Total of 30 chicken meat samples were soaked with infused bay leaf (0% and 15%) for 30 minutes and different storage times (0, 2, 4, 6, and 8 days) at 4°C. Physical characteristics (pH, cooking loss, and tenderness) and the total of microbial (Total Plate Count) were evaluated. Soaking and storage time did not affect the physical characteristics of chicken meat, but it could decrease the color value and increased the aroma value of raw meat, as well as the tenderness and aroma of cooked meat. The use of bay leaf infusion (*S. polyanthum*) can minimized the total number of microbes in chicken meat during storage at refrigerator temperature. There was no interaction between storage time and infused concentration on the physical and sensory characteristics of chicken meat. It could be concluded that the use of *S. polyanthum* presented antibacterial against pathogenic microbes and improved the sensory quality of meat.

Keywords: Chicken meat, bay leaf, storage time, physical quality, total plate count.

1. INTRODUCTION

Chicken meat is one of as the most widely consumed animal proteins in various countries [1]. It is considered as relatively low cost and as a healthy alternative due to its low fat content, versatility [2], high nutritional value, and distinct flavor [3]. Perishable and vulnerable shelf life are disadvantage of fresh chicken meat [4]. In addition, the availability of nutritional value in meat, such as proteins, fat, free amino acids, mineral salts, vitamins and water content are factors that support the growth of microorganisms, especially during processing, storage, and distribution of chicken meat, both at the retail and consumer levels. [5]. Undesirable quality changes in chicken meat can occur due to these microorganisms, especially contamination caused by lactic acid bacteria as microorganisms that are closely related to meat spoilage [6]. There is an impact in the form of a financial burden that must be borne by the producer because of the damage to chicken meat. Therefore, the procedure for extending the shelf life of meat and its quality are urgently needed considering that

meat spoilage is a major problem encountered in the meat processing industry [7].

Many synthetic preservatives in the food industry are used to suppress microbial growth and thereby extend the shelf life of meat, such as butyl hydroxylanisole (BHA), butyl hydroxytoluene (BHT) and tertiary butylhydroquinone (TBHQ) [8]. But on the other hand, the adverse effects of BHT, TBHQ, and BHA endanger human health, some of which are characterized by allergies, headaches, asthma, to dermatitis [9]. Recent study have been conducted on the utilization of natural antioxidant that indicates their capacity and safety [10]. The advantages of natural ingredients such as essential oils and plant extracts include the discovery of antimicrobial properties in them which intensive research has tested and found promising results [11]. These natural preservatives are contained in spices, which are rich in phenolic compounds as it can improve food quality by reducing lipid oxidation and microbial growth. [12].

These day, the useful substances such as antimicrobial and antioxidant in plants have been used

to replace the synthetic preservatives [13], for example the use of Hyssop (*Hyssopus officinalis* L.) on the shelf life of ground beef [14]. Another useful plant as natural antioxidant is *S. polyanthu*, which is rich in phenolic compounds. *S. polyanthum* leaves contains the compound of triterpenoid, flavonoid, carbohydrate, saponin, tannin, alkaloid [15], and polyphenols [16], therefore it can plays a role as an antioxidant and antibacterial agent [17].

To our knowledge, there have been no studies that have tested the antioxidant and antimicrobial effects of *S. polyanthum* on the storage of raw chicken meat with variations in storage time. Summarizing the above explanation, this work aims to determine the effect of *S. polyanthum* on physical and microbial qualities.

2. MATERIAL AND METHODS

2.1. Material

Material. The materials used in this study consisted of 32 days old Lohman broiler chicken breast, bay leaf, distilled water, buffer solution (pH 7 and pH 4), Plate Count Agar (PCA), and buffered peptone water (BPW) 0,1%.

2.2. Methods

Producing Bay Leaf Infusion. Salam or Indonesian bay leaves were obtained from traditional markets in Yogyakarta (Gendeng Market, Prambanan, Sleman, Yogyakarta, Indonesia). The infusion was made by extracting the simplicia of bay leaves with water at 90°C for 15 minutes [18]. The selected bay leaves in this study were dark green and leaves after the 3rd leaf from the shoot. Production of bay leaf infusion was carried out in the following steps, the leaves of fresh bay were balanced using analytical weighing scales, trimmed to reduce the size, washed, placed in a pan, and then added distilled water according to the desired infusion concentration, then heated in a pan for 15 min at 90°C. The production of bay leaf infusion refers to the Director General of Drug and Food Control, Republic of Indonesia (Dirjen POM RI) by weighing the bay leaves as needed. To produce 15% infusion, it takes 15 g of bay leaves then added by water to a volume of 100 mL. Then the solution was filtered with a sterile cloth. The concentrations of the infusion made were 0% and 15%.

The Preparation of Chicken Meat. The material used in this study was the breast meat of Lohman strain chicken aged 32 days (Royan Chicken Processing, Yogyakarta, Indonesia). A total of 30 samples of chicken meat were divided into 5 groups which were differentiated based on storage time (0, 2, 4, 6, and 8 days). The chicken meats were then soaked in bay leaf infusion with the concentration of 0% and 15% for 30

minutes. The chicken meats were stored at a refrigerator temperature of 4°C with non-vacuum packaging.

pH Value Determination. To determine the pH of the sample, measurements were made with a laboratory pH-meter (Hi98107 Hanna Instrument) [19]. Minced meat weighing 2 g was homogenized in 18 mL of distilled water. The resulting slurry was measured the pH value using pH-meter (accuracy ± 0.01 pH units). For calibration of pH meter, 2 buffer solutions consisting of acid buffer (pH = 4.00 ± 0.05) and neutral buffer (pH = 7.00 ± 0.01) were performed. The pH value was then expressed as the average of the three determinations

Warner-Bratzler Shear Force (WSBF) Determination. The determination of WSBF was carried out with slight modifications [20]. At this stage, the prepared meat was placed in a vacuum plastic and then cooked in a water bath at 80°C until the inside temperature of water bath was 70°C. The sample was then cut in the direction of the meat fiber where the cross-sectional size made was 1.5 cm x 0.07 cm [21]. Measurements were carried out 3 times at different places. The WSBF value in this case was calculated as the average reading for the core of the same steak. The tenderness value was expressed in kg/cm²

Cooking Loss Determination. Chicken meats were trimmed towards fiber direction and weighed approximately 25 g. They were placed into polyethylene plastic and vacuum packed with a vacuum machine. Cooking loss was determined with a little modification [21]. At this stage, the sample was poured directly into a water bath (the sample is still in a vacuum plastic at this time) at 60°C for 20 minutes. The temperature was then raised to 80°C and waited for 30 minutes. Absorbent paper was used to remove excess moisture before the sample is finally weighed. The result of this process was expressed as a percentage of weight loss compared to the initial weight [22]. Chicken meats were trimmed towards fiber direction and weighed approximately 25 g (x). They were cooled (thawed) in their sealed state with running water. They were removed from their polyethylene plastic then wiped with tissues and weighed their final weight.

$$\text{Cooking loss (\%)} = \frac{X-Y}{X} \times 100\%$$

X = Initial Weight
Y = Final Weight

Total Bacteria. The bacteria test was determined with a little modification [23]. One gram of chicken meat was poured into a test tube containing 9 mL of sterile 0.1% buffered peptone water (BPW) as a 10⁻¹ dilution. Then 1 mL was taken and inserted into a test tube containing 9 mL of sterile 0.1% BPW as a 10⁻² dilution and so on until the 10⁻⁵ dilution. Then 1 mL was

taken and planted in a petri dish containing plate count agar (PCA) media in duplicate with a dilution of 10^{-2} , 10^{-3} , and 10^{-4} . Then incubated at a temperature of 34°C to 36°C for 24 h. Count the number of colonies in each series of dilutions. Colonies counted were petri dishes with a total of 25 to 250 colonies [24].

3. RESULT AND DISCUSSION

3.1. pH Value

This study found that there was no significant effect of infused bay leaf and storage time on the pH value of chicken meat. In general, pH mean of chicken meat sample is presented in Table 1. The mean pH value of 0% treatment is 5.86, while 15% treatment is pH 5.73.

Table 1. pH test results of chicken meat with the addition of bay leaf infusion at different storage

Storage time (days)	Concentration (%)		Average
	0	15	
0	5.95±0.16	5.91±0.15	5.93±0.12
2	5.71±0.30	5.42±0.31	5.56±0.12
4	5.73±0.28	5.65±0.50	5.69±0.12
6	5.94±0.22	5.86±0.32	5.90±0.12
8	5.96±0.21	5.83±0.44	5.89±0.12
Average	5.86±0.23	5.73±0.36	

ns: non-significant

The pH value of two different treatments of chicken meat did not show a significant value. Both pH values in the treatment are still in the normal range of chicken meat. The normal pH after one-hour slaughtering is 6.9 to 7.1 and after 24 h slaughtering is almost 5.7 to 5.9 [25]. Chicken meat has a pH that tends to be almost the same as the pH of the bay leaf solution, which is in the range of 5.4 to 5.74 [26]. It was worth mentioning that chicken meat's pH might be also influenced by the pH of bay leaf infusion. The results of the study are in accordance with previous research conducted that the bay leaf solution had no significant effect on broiler chicken meat [27].

3.2. Cooking Loss

The result presented in Table 2 shows that the cooking loss increased during the storage time. Even so, the treatment given was found to have no significant effect ($p>0.05$) on cooking loss. Cooking losses for concentrations of 0 and 15% were 30.21% and 30.92%, respectively. There was no significant difference in the cooking loss value due to the immersion treatment and storage time, possibly related to the pH value, which was also not significantly different. In other words, the

factor that affects cooking loss is the pH value of the meat followed by the ability of the meat to bind water. [28]. The results of this study are in line with other research that stated that broiler chicken meat soaked in musk orange juice and stored at -2°C to 4°C did not give a significant difference to the value of chicken meat cooking losses [29].

Table 2. Cooking loss of chicken meat with the addition of bay leaf infusion at different storage times (%)

Storage time (days)	Concentration (%)		Average ^{ns}
	0	15	
0	29.87±2.50	32.15±2.11	31.01±1.55
2	28.98±3.05	27.18±5.50	28.08±1.55
4	30.35±1.50	30.58±2.81	30.47±1.55
6	30.24±2.92	32.42±6.36	31.33±1.55
8	31.62±3.79	30.92±4.47	31.94±1.55
Average ^{ns}	30.21±2.57	30.92±4.35	

ns: non-significant

The study revealed that storage at 4°C with different storage times also had no significant effect on meat cooking losses. This proves that chicken meat with a shelf life of up to eight days at 4°C is still in good condition.

3.3. Tenderness

Based on the data presented in Table 3, it was known that there was a significant effect of the treatment of soaking chicken meat on the tenderness value of broiler chickens. The statistical test showed that the immersion treatment using 15% bay leaf extract reduced the tenderness value by 18.13% ($P<0.05$), from $3.97+1.52$ to $3.25+1.35$.

Table 3. The tenderness of chicken meat with the addition of bay leaf infusion at different storage times (kg/cm^2)

Storage time (days)	Concentration		Average
	0	15	
0	6.40±0.31	5.47±1.51	5.93±0.32 ^p
2	3.96±1.23	3.24±0.57	3.60±0.32 ^q
4	3.88±0.75	2.48±0.36	3.18±0.32 ^q
6	2.74±0.36	2.71±0.07	2.73±0.32 ^q
8	2.85±0.91	2.35±0.47	2.60±0.32 ^q
Average	3.97±1.52 ^a	3.25±1.35 ^b	

^{a, b} Values on different superscripts on the same line show significant differences ($P<0.05$)

Table 4. Total Plate Count (TPC) of chicken meat with the addition of bay leaf infusion at different storage times (log cfu/g)

Concentration (%)	Storage time (day)					Average
	0	2	4	6	8	
0	4.76±0.15	5.14±0.44	5.39±0.36	5.95±0.18	6.4±0.07	5.53±0.65 ^a
15	4.52±0.07	4.7±0.17	5.22±0.12	5.73±0.18	6.3±0.12	5.29±0.69 ^b
Average	4.64±0.17 ^a	4.92±0.38 ^b	5.3±0.26 ^c	5.84±0.2 ^d	6.35±0.11 ^e	

^{a, b, c, d, e} Values on different superscripts on the same line show significant differences (P<0.05).

^{p, q} Values on different superscripts on the same line show significant differences (P<0.01)

Soaking treatment for 2 days also reduced the meat tenderness value (P <0.05), from 5.93±0.32 kg/cm² to 3.60±0.32 kg/cm². However, further tests showed that there was no interaction between treatments on the variable value of meat tenderness. The mean value of tenderness of meat with 0% treatment was 3.97 kg/cm², while the 15% treatment was 3.25 kg/cm². The decrease in meat tenderness value was caused by the antioxidant and antibacterial content in the bay leaf extract, these compounds can act as a tenderizing agent with phenol content in the bay leaf infusion. The meat soaked in bay leaves infusion had a higher level of tenderness, presumably due to the antioxidant effect of bay leaf infusion on the calpain enzyme in chicken meat. The calpain enzyme is a proteolytic enzyme that plays a role in breaking certain peptide bonds, which causes the tenderness process at the beginning of postmortem [30]. This is consistent with research conducted by [21] namely the use of vitamin E as an antioxidant, can increase meat tenderness because vitamin E can protect the calpain enzyme from oxidation.

The second day of storing meat at 4°C showed an increase in the tenderness value, this increase was due to the enzyme activity that occurred in the withering process. In the post-frying phase, the pH value has decreased, this is related to the tenderness of the meat. During a decrease in meat pH, proteolytic enzyme activity occurs, namely the enzyme CANP (Calcium-Activated Neutral Proteinase) and cathepsin [31]. The CANP enzyme will be active at the beginning of the withering process around pH 6.5 to 8.0 which functions to degrade myofibrils (actin and myosin). After the CANP enzyme works, then the cathepsin enzyme is active and works in the range of 3.7 to 7.0 which functions to degrade myofibrils and collagen, thus causing the meat to become more tender.

3.4. Total Plate Count

The results in table 4 show that the total bacteria of chicken meat with immersion treatment and different storage times at refrigerator temperature had a significant effect. The mean total of meat with 0%

treatment was 5.29 log colony forming unit (cfu)/g, while 15% treatment was 5.53 log cfu/g. This shows that the bay leaves have good inhibitory power. The mean of total microbes in chicken meat increased with increasing storage time. The highest microbial total was reached on the 8th day, namely 6.35 log cfu/g. The number of MI microbial samples before storage at refrigerator temperature showed smaller results (4.52 log cfu/g) than the control (4.76 log cfu/g). This shows that bay leaves have inhibitory power because they contain tannins, flavonoids, and triterpenoids.

This acts as a change in membrane permeability, changes in numerous intracellular structures caused by hydrogen binding of phenolic compounds to enzymes [32]. As with phenols, flavonoids work as antimicrobials by binding to proteins through hydrogen bonds, resulting in damage to protein structure, disturbed cell wall instability, and cytoplasmic membranes. Disruption of cytoplasmic integrity causes the escape of macromolecules from ions so that cells lose their shape and become lysis [33].

4. CONCLUSION

In conclusion, soaking chicken meat in bay leaf infusion (*S. polyanthum*) with different storage time can increase the tenderness of chicken meat and inhibit microbial growth until 4th day. However, bay leaf infusion did not give significant effect on the pH and cooking loss of chicken meat.

AUTHORS' CONTRIBUTIONS

Study conception and design ES, J; data collection: UA, NA; analysis and interpretation of results: ES, J, UA, and NA; draft manuscript and preparation: UA, and NA. All authors reviewed the results and approved to final version of manuscript.

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